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# FLOOD CONTROL SURVEYS

## IN THE NORTHEAST

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NORTHEASTERN FOREST EXPERIMENT STATI

## FOREWORD

Floods are a grave danger to our Nation's resources. It is estimated that floods cost the United States at least $100 million every year. The recent Mississippi floods, which dramatically brought the seriousness of the situation to public attention, cost half a billion dollars in direct damages. The Northeast carries a heavy burden of flood losses. In 1936, floods cost the Northeastern States $250 million direct damages.

The damage done by flood waters is, unfortunately, only a small part of the loss. Water running unchecked off farmlands and woodlands washes away the valuable topsoil that we need to grow our food. It washes down the drain the commonest, yet the most valuable, natural resource we have.

History tells us that great flourishing civilizations have slowly died and vanished because their lands, impoverished by such erosion, became unable to support them. Of these civilizations little remains today except the ancient ruins that archeologists manage to dig up. It could happen to us.

Recognizing that floods are a great danger, the Congress has authorized flood-control surveys to determine what should be done. Surveys are now being made in the Northeastern States. The principles of the flood-control program, and some of the factors considered in making a flood-control survey, are outlined in this paper.

Originally presented before the Allegheny River Improvement Association in June 1947, and entered in the Congressional Record 93: A3249-3250 by the Hon. Leon H. Gavin of Pennsylvania, this paper is presented in this form in response to numerous requests for information about flood-control surveys.

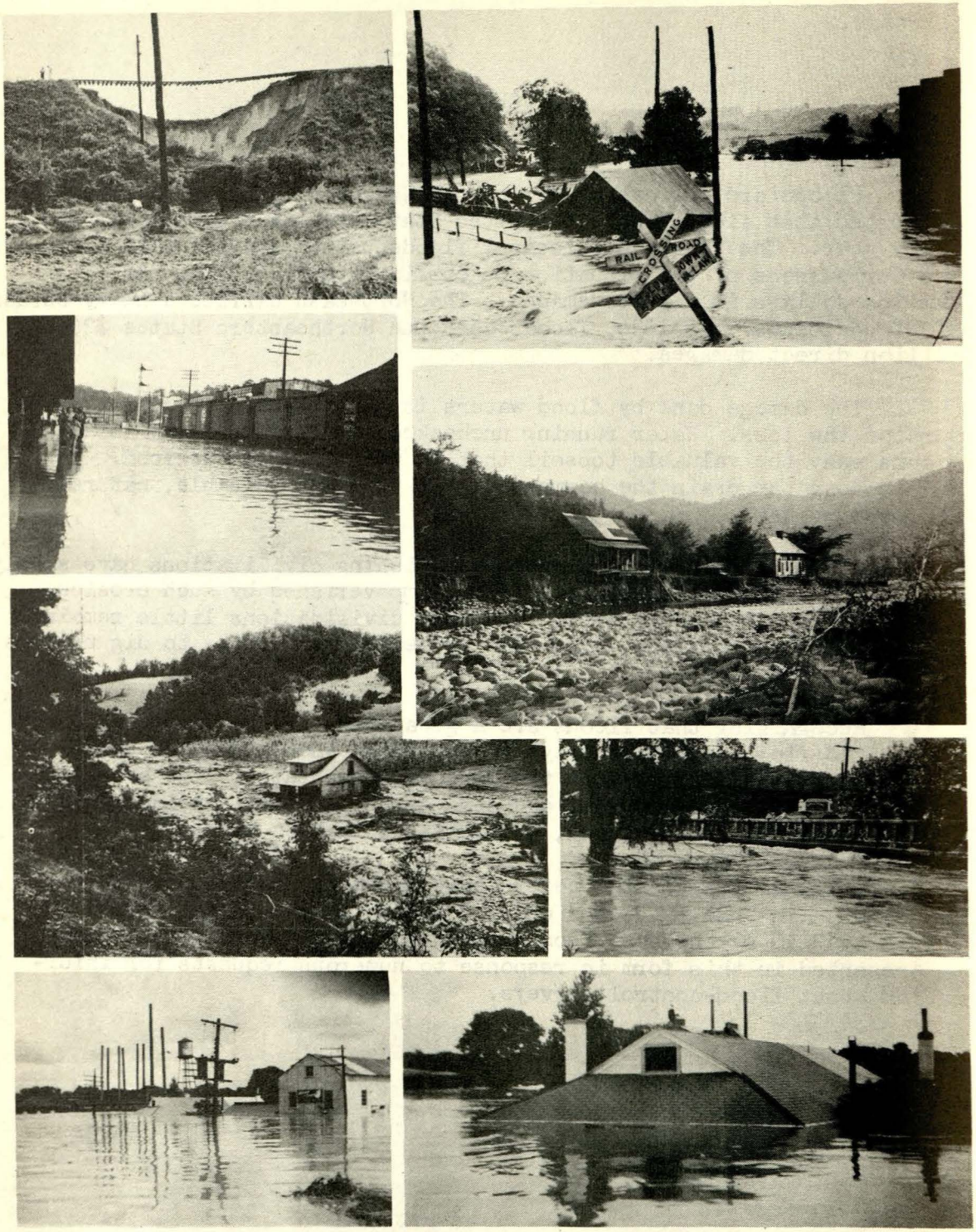


Figure 1.--Flood waters cause heavy losses in the Northeast every year. In addition to the damage they do, they carry away countless tons of the soil that we need to grow food.

# FLOOD-CONTROL SURVEYS IN THE NORTHEAST

by Arthur Bevan[1/]

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We all remember the floods of March 1936 in the Northeast. Following these memorable floods, which caused enormous losses, Congress passed the Omnibus Flood Control Act of 1936. Although Congress had previously recognized the flood problem in the Mississippi Delta region, it had given comparatively little attention to the situation elsewhere. Deeply concerned with the Nationwide extent of the losses and their magnitude, the Congress authorized a comprehensive national attack on the problem. In this it called upon both the engineers of the War Department and the technicians of the Department of Agriculture.

The act authorized and directed the Secretary of Agriculture "to make preliminary examinations and surveys for runoff, waterflow retardation, and soil erosion prevention." Department of Agriculture activities under this legislation began in 1937 and continued until June 1942, when work was suspended because of the war. These activities were resumed in July 1946. Preliminary examinations were made on a number of watersheds in the Northeast, including the Allegheny River. On the basis of these, more extensive surveys have been authorized on several watersheds. Such surveys of the Connecticut and Merrimack Rivers are now in process of completion for submission to Congress. The Secretary has authorized, among others, a survey of the Allegheny River, to be initiated when the financial situation permits.

## Land use is basis of program

The Department has assigned these flood-control surveys to the Soil Conservation Service and the Forest Service. Primary responsibility for them, including reports, has been assigned according to the predominate land use in a watershed. The Forest Service has primary responsibility for the survey on the Allegheny watershed. However, both agencies participate in the work and collaborate on the findings.

The purpose of the survey is to develop a comprehensive program for flood control by watersheds. The program is based primarily on land-use management, and all aspects of land use and its effect on runoff and water conservation must be considered. Damages from floodwater and sedimentation affect the entire economy of the watershed. It is, therefore, necessary to consider in the surveys all types of land use and to

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Figure 2.--Good forest cover produces good soil. The trees and shrubs protect the forest floor, and the soil is rich and porous. It soaks up water like a sponge.

evaluate flood and sediment damages on such diverse items as agricultural land, urban and industrial areas, transportation systems including railroads and highways, power and water utilities, fish and wildlife, and recreation.

The soil is a reservoir

The soil in any watershed is a great reservoir, but like any reservoir it has its capacity. When it is filled, spill occurs. Also, if the condition of the soil is such that water is unable to enter the ground at the rate it is falling, it must go somewhere--and surface runoff occurs. Soil differs from man-made reservoirs, however; the condition, depth, and type of soil all govern the rate at which water will enter and will be trapped in this reservoir.

Vegetative cover is the control gate which determines the rate and amount of water entering the soil reservoir; so cover conditions are of primary importance in these surveys. Forests under good management produce our best soil conditions. They maintain the land in a condition so it can receive maximum rainfall and can release this water slowly to the streams and rivers, just as a flood-control reservoir releases pent-up water.

The forest floor is protected by the crowns of trees at different heights and the mass of shrubs and ground plants below. The ground surface itself is a mat of dead leaves, twigs, and other plant remains. Beneath this loose litter is a layer of partly decayed vegetation, and below that a mass of more or less completely rotted organic matter. Underneath these organic layers is mineral soil, also in layers. The top portion is considerably enriched with organic material, and is shot through with growing and decayed plant roots and the minute channels of innumerable earthworms, mites, insect larvae, bacteria, and fungi working constantly throughout the soil. All this biological activity keeps the soil porous and gives it a crumbly structure that is ideal for soaking up, storing, and filtering large amounts of water. Good forest soils, which absorb water quickly, can hold 50 percent or more of their total volume. The depth of the soil thus becomes a determining factor.

Poor forests a source of flood water

But do not be fooled. We may look across a valley and see what looks like good forest cover, but close inspection will show that it is far from good. It may be pastured; and while the cover looks find from a distance, actually the soil has been compacted by the hoofs of cattle, the underbrush is gone, and most of the humus, so valuable for flood control, has been destroyed. Such forest soils have lost their ability to absorb rainfall rapidly. The storage capacity is reduced, just as it is in a reservoir which is filling with silt.

In some places the forest stand may be young, and the soil has not had a chance to recover from clear-cutting or other heavy cutting. Skid

Figure 3.--Grazing in this woodlot has compacted the soil so it cannot absorb water. Erosion has begun.

Figure 4.--Clear-cut and burned forests leave the ground exposed to erosion.

roads downhill have not healed; they act as channels for quick concentration of runoff. Or, the area may have been burned in the past, destroying the humus, and it may be years before the damage is repaired. All these things will have a serious effect on the rate of runoff and erosion. Have you ever walked in the forest and felt that the ground is soft and spongy? Such a forest is in good condition for flood control. It is possible to walk into the woods blindfolded and make a good estimate of its condition, just from the way the ground feels underfoot.

Good farming practices help

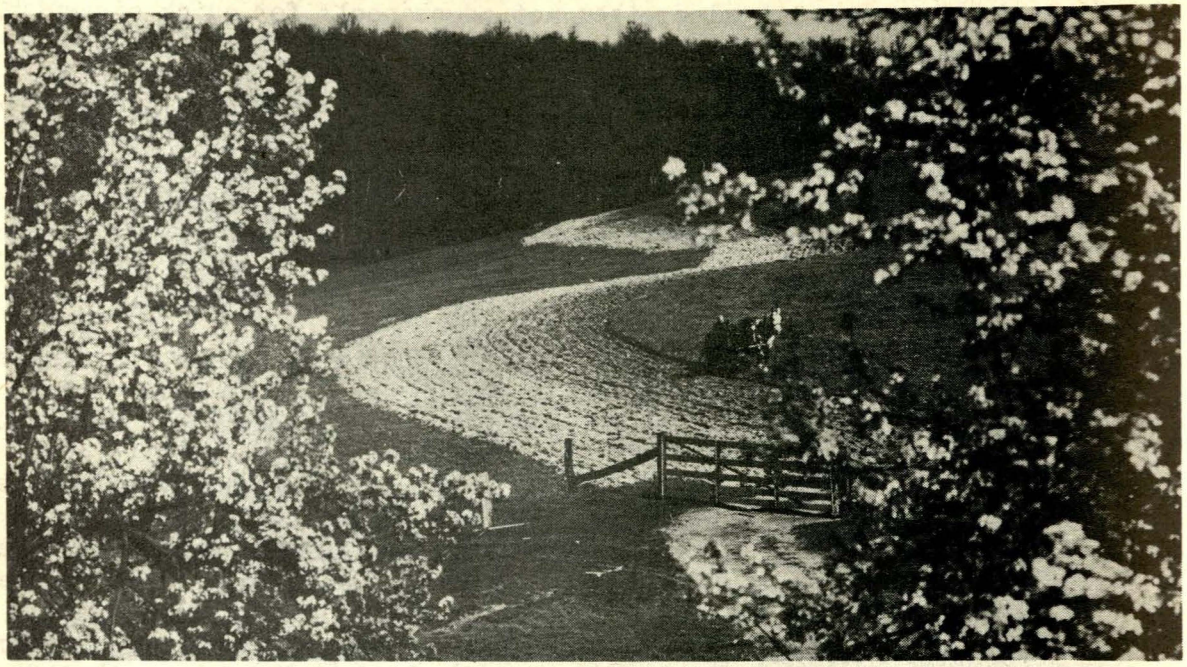
We must not forget, however, that in addition to the forest lands there are agricultural lands. Land fitted for agriculture should be used for that purpose. These lands should be farmed under the best soil and water conservation practices. Such practices make a definite contribution to flood control. In addition, they pay cash dividends to the farmer in better crops and pastures, and they maintain the fertility of the soil for the general welfare of the watershed and the economy of the Nation. Good pasture, besides feeding more stock, will retain much more water than poor pasture. Strip cropping, contour plowing, diversion ditches, contour furrows, and all the other conservation practices recommended by the Soil Conservation Service make a substantial contribution to flood control. There is ample data to show that good land-use management will pay dividends through reductions in runoff.

In a land-management program for flood control, maximum benefits accrue from improvement of the soil both in its capacity to retain moisture and in the rate at which water can enter the ground.

Many other benefits

There are many benefits from good watershed management in addition to those obtained for flood control. For example, we all like to fish and hunt. The condition of the land determines the very occurrence of fish and wildlife. The farm, the forest, and the stream have their characteristic forms of living creatures. The available food, cover, water, and many other environmental factors help to determine the kind and number of fish and wild animals. What man does to the land is what determines how good our hunting and fishing will be. We expect to produce fish and wildlife as a result of good watershed management. When land is used intensively in accord with its natural capacity, the pattern of the land takes a new shape, and to this pattern wildlife readily adapts itself.

Strip cropping, a procedure recommended for checking runoff and reducing soil erosion, will result in twice the number of ground-nesting birds in a similar area that is planted solidly to meadow. In wooded areas we recommend fire protection, elimination of grazing, and selective cutting. Ungrazed woods are about twice as productive of wildlife as grazed woods. Reduction of sediment in streams through flood-control practices on the land will provide better fishing. I could go on and enumerate the many other benefits that would accrue from good land use



SOIL CONSERVATION SERVICE

Figure 5.--Good farming practices help to save the soil.

SOIL CONSERVATION SERVICE

Figure 6.--Floods have ruined many a farm and many a crop.

and water management, such as clean water for domestic and industrial use, more water during periods of low flow, conditions more favorable for recreation, etc.

The damage can be repaired

How much of the land in the Allegheny watershed is in good condition? We only have to look around to see the land abuse that has taken place since early settlement. The damage done in the past century and a half cannot be repaired overnight, but we know it can be repaired.

For example, take the flood problem at Bradford, Pa. Here is a problem to challenge flood-control technicians. The city has encroached on the flood plain of Tuna Creek until the river channel is only a large flume through the city. The watershed above Bradford has been terribly abused. Access roads to oil wells have been bulldozed straight uphill without any planning. Power lines, water mains, gas mains, excessive clearing of the land for drilling, all have and are being done without any consideration of runoff and water management. This watershed is still deteriorating, and of Bradford the best that can be said is "the worst is yet to come." We doubt that the situation can be completely solved. Much, however, can be done and the hazard can be materially reduced. Channel improvements and flood walls installed by the engineers will help. A land-use and watershed-management program would also help materially. We are fairly certain that both will be necessary to a reasonably satisfactory solution to the problem. This is not a large area, but it contains most of the elements contributing to flood in the Allegheny watershed and is well worth an inspection by interested persons.

Flood control will pay

In the process of our flood-control surveys we are required to estimate the cost of any proposed program and to evaluate the benefits that will accrue. The cost-benefit ratio must be better than a dollar of benefits for each dollar of costs. A plan of improvement proposed by the Department of Agriculture takes into account all possible flood-control practices necessary to accomplish maximum reductions in flood damage. Small reservoirs, dikes, channel improvements, and similar engineering structures are considered. However, as a comprehensive program, it must be integrated with the program of the United States Army's Corps of Engineers and those of any other agencies that contribute to the control of floods.

As I have said before, the damage that has been done to the lands in our watersheds cannot be repaired immediately. It must be realized that maximum benefits from a land-use and watershed-management program are fully realized only after a long period of time. As usual, we have to pay the bill for our misdeeds. There will be substantial benefits, however, along the way. I want to emphasize our belief that the best approach to flood control is a comprehensive, integrated program, including engineering structures and land-use practices, which

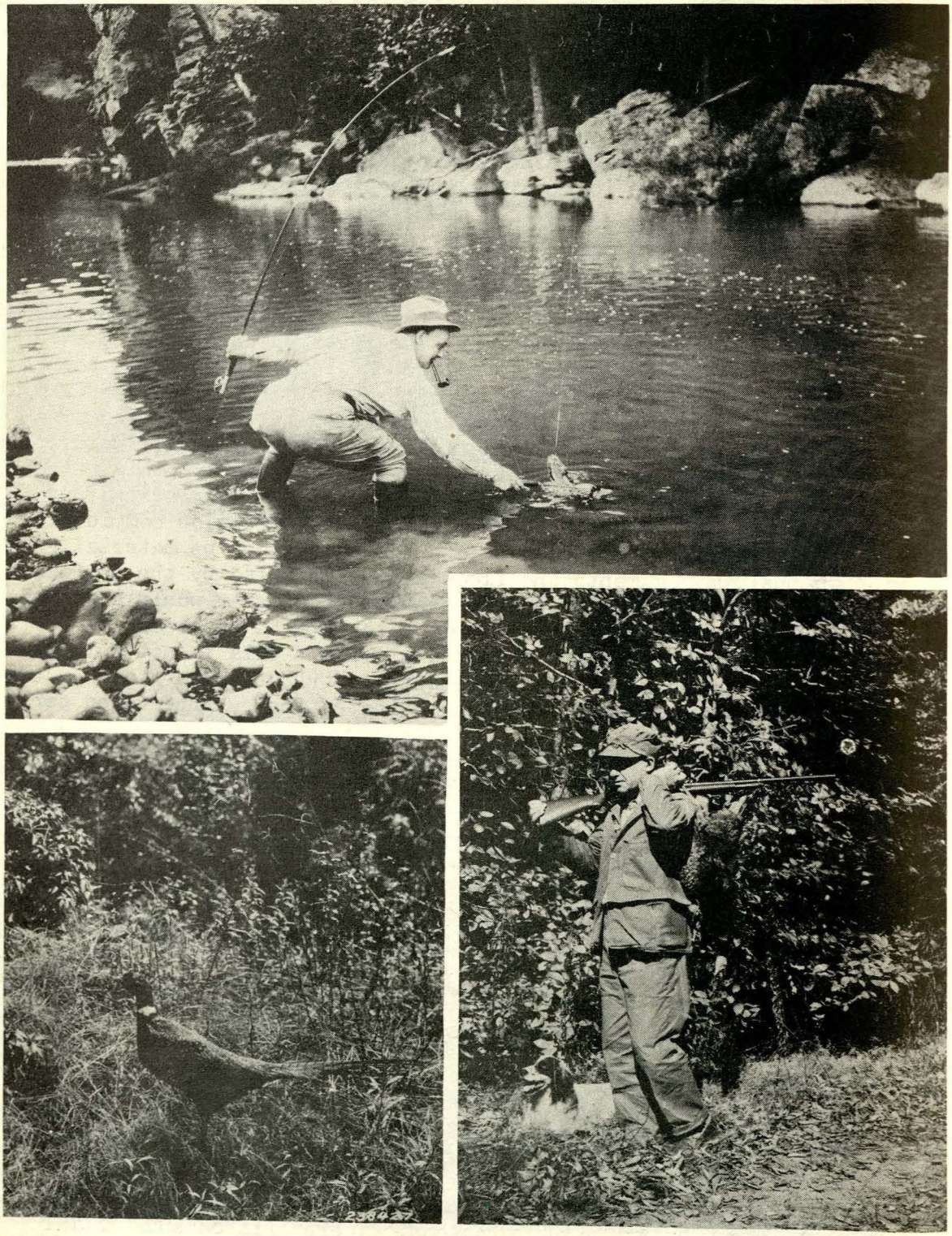


Figure 7.--Better fishing and hunting are among the many benefits of a flood-control program.

will produce the most flood control for the least cost.

> As the Secretary of Agriculture said is his report for 1943: "In order to achieve the greatest possible benefit in the shortest time, it is essential that the upstream and downstream phases of flood control be properly timed and coordinated, through the development of one over-all plan for each of the major flood-contributing watersheds."